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ENHANCEMENT OF
COMPUTER PROGRAM EAGLE

Volume I: Enhancement Summary

May 1978

Prepared for

AERONAUTICAL SYSTEMS DIVISION
Wright-Patterson Air Force Base, Ohio

ARINC RESEARCH CORPORATION

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Under Contract F33657-77-D-0029-0012

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ABSTRACT

A project conducted by ARINC Research Corporation
to enhance the capabilities of computer program EAGLE is
described. Results of the task, performed for Aeronautical
Systems Division, are presented as follows: Volume I, proj-
ect summary; Volume II, EAGLE program listing; and
Volume III, QUICK program listing.

FOREWORD

This three-volume report documents a project to enhance the capabilities of the on-line (interactive) computer program EAGLE, and the development of three new computer programs, QUICK, PURGNOW, and EST1000. These tasks were performed under Contract F33657-77-D-0029-0012 with Aeronautical Systems Division.

EAGLE was developed for ASD by ARINC Research under Contract F33657-77-D-0007, and its basic features are described in the final report under that contract.* EAGLE enables calculation of acquisition costs for any type of system, and can readily be used to perform a broad range of other types of calculations. This report on EAGLE enhancement is divided as follows:

Volume I — Enhancement of Computer Program EAGLE: Enhancement Summary

Volume II — Enhancement of Computer Program EAGLE: EAGLE Program Listing

Volume III — Enhancement of Computer Program EAGLE: QUICK Program Listing.

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*ARINC Research Corporation, Computer Program EAGLE, three volumes, Publication 1977-01-1-1653, September 1977

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CONTENTS

Early in 1978, a change was made to the system operating procedure for the CDC 6600 data processing system at Wright-Patterson Air Force Base. While this change increased computer speed and general user capability, it also reduced the memory available to the intercom user. Among the programs affected was EAGLE, a program developed by ARINC Research Corporation for ASD to perform a variety of cost and other types of calculations. Prior constraints on user memory had necessitated dividing EAGLE into two programs, EAGLE1 and EAGLE2. The CDC 6600 system procedure change further reducing user memory necessitated the modification of EAGLE into three programs, EAGLE1, EAGLE2, and EAGLE3, as described in this report.

Additionally, the new system operating procedure changed the operation of the system routine PERMFIL, which is extensively used by EAGLE. Re-establishment of the EAGLE-PERMFIL interface was accomplished by ARINC Research in conjunction with computer system personnel at WPAFB.

In response to user requests, some further modifications were made to EAGLE, and two new programs, PURGNOW and EST1000, were created. These programs are for file maintenance and cost/schedule relationship estimating, respectively.

Finally, three major programs, QUICK1, QUICK2, and QUICK3, similar to the EAGLE programs, were created. These programs are for use when a file supplies the input. They are preferable in this case to the corresponding EAGLE programs because the QUICK programs suppress the prompting requests.

The foregoing activities are summarized in this volume. Volume II provides a listing of the three programs comprising EAGLE, while Volume III provides a listing of the three programs comprising QUICK.

In the main, the revised EAGLE1 and EAGLE2 programs function much the same as their predecessors. EAGLE3 was created to enable the user to retain the capability of spreading the cost data.* The need to spread the cost data arises when funds are to be expended over several years even though these funds are initially calculated for expenditure in a single year.

Except for the changes mentioned in Section 2.1, the subroutines, as described in Reference 1, remain unchanged. As before, when a subroutine is not to be included in a program its "skeleton" is substituted. This skeleton contains a statement to the effect that the routine is not included in the program being used. However, the subroutines TRANSTO, TRANSFR, HELP, and INTEPR have been completely removed from all EAGLE programs. Table 2-1 depicts the status of all subroutines for each EAGLE program.

The purpose and application of the QUICK program is discussed in Section 2.2; and two new programs prepared for use in conjunction with the output from EAGLE are described in Section 2.3.

2.1 CHANGES TO EAGLE

2.1.1 General

The following three major changes were made to EAGLE:

a. The user is now given the opportunity, with the first request made in subroutine ESCALAT, to request a detailed explanation of ESCALAT.

b. The user can now input a title of his choice for the output data.

c. The output format was changed to make it more suitable for direct inclusion in reports and presentations. An example of the new output format is shown in Figure 2-1.

In addition, changes were made to accommodate the removal of routines INTEPR, HELP, TRANSTO, and TRANSFR, and to clarify some of the request statements.

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*A guide to the use of EAGLE is provided in the Appendix.

TABLE 2-1. ROUTINE STATUS FOR EACH EAGLE PROGRAM

	P = Presently in indicated program R = Removed from indicated program S = Skelton in indicated program		
	Program		
Routine	EAGLE1	EAGLE2	EAGLE 3
MAIN	P	P	P
CAL	P	S	S
CAL2	P	S	S
SPREAD	S	S	P
CAL1	P	S	S
OUT	S	P	S
PRODUC	P	S	S
ESCALAT	S	P	S
HARCON	P	P	P
CAL3	P	S	S
CAL4	P	S	S
CAL5	P	S	S
NEWRA	P	S	S
HELP	R	R	R
ADDL	P	S	S
FILES	P	P	P
ROWMOD	P	S	S
DIVIDEL	P	S	S
ELEMENT	P	P	P
RINSERT	P	S	S
CUM	P	S	S
APRINT	P	P	P
GCS	P	P	P
INTEPR	R	R	R
T1SL	P	S	S
CINSERT	S	S	S
NAMECK	P	P	P
TRANSTO	R	R	R
TRANSFR	R	R	R
MULT	P	S	S

```
                              ***EAGLE TEST RUN***

                               1977 YEAR DOLLARS
                                 (IN MILLIONS)

FISCAL YEARS
        1980            1981            1982            1983            TOTAL
AIRFRAME

        1.900           1.656           1.545           1.473           6.574
PROPULSION

        1.000            .900           1.510           1.302           4.712
SYS/MGMT

         .950            .828            .772            .736           3.287
NON-REC

         .100            .100            .100            .100            .400
DATA

         .200            .176            .164            .157            .697
     CAE

        0.000           0.000           0.000           0.000           0.000
SUBTOTAL(ROW1+ROW2)

        2.900           2.556           3.054           2.775          11.286
AGE

         .000            .000            .000            .000            .000
TRAINING

        5.343           4.657           4.343           4.142          18.485
///LOTS///

         .400            .350            .327            .312           1.389
***CHECK***

        1.900           1.656           1.545           1.473           6.574
```

Figure 2-1. Example of New EAGLE Output Format

2.1.2 Changes to Documentation

In Section 3.2.3.2 (a) of Volume 1 of the previously referenced ARINC Research Report (1977-01-1-1653), the term

$$\prod_{k=y}^{x-1}$$

should be replaced by

$$\prod_{k=y+1}^{x}$$

2.2 PROGRAM QUICK

EAGLE includes a procedure that records each user response, and at the end of an analysis these responses can be saved on file. Thus an identical run can be made using the saved file as input, eliminating the response to each request. This greatly reduces the user's time at the terminal. Further, the saved file can be modified, thus enabling sensitivity analyses to be quickly performed.

Though the user need not respond to requests in this method of operation, each request is printed over the terminal. This not only takes time, but provides unwanted printed copy. To eliminate the printing of these requests, three programs (QUICK1, QUICK2, and QUICK3) were created which omit the request statements. Except for the suppression of the requests, these programs are equivalent to EAGLE1, EAGLE2, and EAGLE3, respectively. Thus when using a file as input, the user should choose a version of QUICK as opposed to the corresponding version of EAGLE.

2.3 ADDITIONAL PROGRAMS

Two additional computer programs were prepared for use in conjunction with output from EAGLE. These programs are described below.

2.3.1 PURGNOW

This discussion of PURGNOW, which was developed before the CDC system change, is included for the sake of completeness. After the CDC system change it was preferable to remove the routines TRANSTO and TRANSFR in order to reduce program memory requirements. With the removal of TRANSTO and TRANSFR, PURGNOW is no longer used.

When TRANSTO and TRANSFR were included in EAGLE, five cycles each of files named ZQE839C, ZQE839H, and ZQE839P would rapidly accumulate in storage.

Four cycles of each of these files, a total of 12 files, had then to be purged. This was a time-consuming process. Thus the reason for the creation of PURGNOW, which purges these 12 files automatically. A listing of PURGNOW is displayed in Figure 2-2.

2.3.2 EST1000

For most military systems, especially those in the research and development phase, there is a schedule of performance and associated funding profile. It is often required to estimate how a change in funding profile would affect the schedule. Such estimates are quite subjective and dependent on many program-unique factors. However, it is desirable that the estimates be performed on a consistent basis and that it consume as little time as possible. To aid the estimation process, EST1000 was created.

The procedure for this estimation involves use of the logistic response function as a cumulative density function for the funding. This function is defined as

$$F = \frac{\exp(\beta_0 + \beta_1 x)}{1 + \exp(\beta_0 + \beta_1 x)} \tag{1}$$

where β_0 and β_1 are constants to be determined, and x represents months. It has been concluded from previous ASD acquisition programs that this function best represents contract performance and expenditures.

The distribution expressed in equation 1 allows the simple transformation

$$p = \ln (F/(1 - F)) \tag{2}$$

and hence,

$$p = \beta_0 + \beta_1 x. \tag{3}$$

β_0 and β_1 can be estimated directly by means of regression analysis using the known portion of the schedule-cost profile information. In EST1000, the user is allowed to terminate at a percentile less than 100, thus allowing some shaping of the new funding schedule.

A program listing of EST1000 is provided in Figure 2-3.

As an example of the use of EST1000, assume that there is a 35-month program which overlaps 4 fiscal years. The first 6 months of the program are in the first fiscal year and the last 5 months in the fourth fiscal year. Further, assume that the funding for the program was to be 6, 12, 15, and 3 million dollars for the 4 fiscal years, respectively.

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Now, let's pose the question, if the funding for the third fiscal year is reduced from 15 to 11 million dollars, what would be the new schedule/funding profile for this program? The use of EST1000 to determine this new profile is exemplified in Figure 2-4.

```
      PROGRAM PURGNOW(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE1)
      INTEGER SUB
      ICY=1
      KK=1
      SUB=9H*ZQE839H*
   77 CALL RETURN(5HTAPE1)
      ERR=0.
      GO TO(102,103,104,105),ICY
  102 CALL PERMFIL(ERR,5HPURGE,5HTAPE1,SUB,2HCY,2,2HPW,4HSAFE)
      GO TO 500
  103 CALL PERMFIL(ERR,5HPURGE,5HTAPE1,SUB,2HCY,3,2HPW,4HSAFE)
      GO TO 500
  104 CALL PERMFIL(ERR,5HPURGE,5HTAPE1,SUB,2HCY,4,2HPW,4HSAFE)
      GO TO 500
  105 CALL PERMFIL(ERR,5HPURGE,5HTAPE1,SUB,2HCY,5,2HPW,4HSAFE)
  500 IF(ICY.EQ.4.AND.KK.EQ.2)SUB=9H*ZQE839C*
      IF(ICY.EQ.4.AND.KK.EQ.1)SUB=9H*ZQE839P*
      IF(ICY.EQ.4)KK=KK+1
      IF(ICY.EQ.4)ICY=0
      ICY=ICY+1
      IF(KK.LE.3)GO TO 77
      STOP
      END
```

Figure 2-2. Program Listing of PURGNOW

```
100=        PROGRAM MAIN(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
110=        DIMENSION C(20),CM(240),CCM(240)
120=        PRINT 100
130=  100   FORMAT(* ENTER THE NUMBER OF YEARS, COUNT ANY PORTION OF A YEAR
140=        *AS A YEAR.*)
150=        READ*,N
160=        NM1=N-1
170=        PRINT 101
180=  101   FORMAT(* ENTER THE YEARLY COSTS.*)
190=        READ*,(C(I),I=1,N)
200=        DO 200 I=2,N
210=        IM1=I-1
220=  200   C(I)=C(IM1)+C(I)
230=        TOTAAL=C(N)
240=        PRINT 102
250=  102   FORMAT(* ENTER THE MODIFIED FUNDING VALUE (CUMULATIVE) AND ASSOCIA
260=        *TED TIME.*)
270=        READ*,TF,J
280=        DEL=C(J)-TF
290=        DO 201 I=J,N
300=  201   C(I)=C(I)-DEL
310=        PRINT 110
320=  110   FORMAT(* ENTER THE NUMBER OF MONTHS IN THE FIRST AND LAST YEAR.*)
330=        READ*,NFYM,NLYM
340=        CM(1)=C(1)/NFYM
350=        IF(NFYM.EQ.1)GO TO 500
360=        DO 210 I=2,NFYM
370=        IM1=I-1
380=  210   CM(I)=C(1)/NFYM+CM(IM1)
390=  500   NXY=NFYM+1
400=        NYZ=12*(NM1-1)+NFYM
410=        KZ=2
420=        KK=0
430=        DO 211 I=NXY,NYZ
440=        IM1=I-1
450=        KZM1=KZ-1
460=        CM(I)=(C(KZ)-C(KZM1))/12.+CM(IM1)
470=        KK=KK+1
480=        IF(KK.EQ.12)KZ=KZ+1
490=  211   IF(KK.EQ.12)KK=0
500=        MK=NYZ+1
510=        MS=NYZ+NLYM
520=        MSM1=MS-1
530=        DO 212 I=MK,MS
540=        IM1=I-1
550=  212   CM(I)=((C(N)-C(NM1))/NLYM)+CM(IM1)
560=        PRINT 451
570=  451   FORMAT(* FOR A DISPLAY OF THE MONTHLY MODIFIED COST PROFILE ENTER
580=        *1, OTHERWISE ENTER 2.*)
590=        READ*,ID
600=        IF(ID.NE.1)GO TO 453
610=        PRINT 1818
620= 1818   FORMAT(* MONTH    CUMULATIVE COST.*)
630=        DO 1000 I=1,MS
640=        PRINT 1001,I,CM(I)
650= 1001   FORMAT(* *,I5,E15.5)
660= 1000   CONTINUE
670=  453   CONTINUE
680=        DO 202 I=1,MSM1
690=        CCM(I)=CM(I)
```

Figure 2-3. Program Listing of EST1000 (Sheet 1 of 4)

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```
700=         CM(I)=CM(I)/CM(MS)
710=  202    CM(I)=ALOG(CM(I)/(1.-CM(I)))
720=         CCM(MS)=TOTAL
730=         SXX=0.
740=         SXY=0.
750=         SX=0.
760=         SY=0.
770=         DO 203 I=1,MSM1
780=         SX=SX+I
790=         SY=SY+CM(I)
800=         SXY=SXY+I*CM(I)
810=  203    SXX=SXX+I*I
820=         B1N=MSM1*SXY-SX*SY
830=         B1D=MSM1*SXX-SX*SX
840=         B1=B1N/B1D
850=         B0=(SY-B1*SX)/MSM1
860=         PRINT 313
870=  313    FORMAT(* ENTER THE PERCENTILE WHICH WILL BE CONSIDED 100 % .*)
880=         READ*,XXX
890=         DO 204 I=1,240
900=         K=I
910=         PN=EXP(B0+B1*I)
920=         P=PN/(1.+PN)
930=         IF(P.GT.XXX)GO TO 205
940=  204    CONTINUE
950=  205    PRINT 103,K
960=  103    FORMAT(* THE NEW NUMBER OF MONTHS IS*,I4)
970=         DELC=(TOTAL/MS)*(K-MS)
980=         PRINT 104,DELC
990=  104    FORMAT(* THE INCREASED COST IS*,E15.5)
1000=        PRINT 1819
1010= 1819   FORMAT(* MONTH, CUMULATIVE %, CUMULATIVE COST, MONTHLY COST.*)
1020=        GTOTAL=TOTAL+DELC
1030=        LX=(J-1)*12+NFYM
1040=        PA=EXP(B0+B1*K)
1050=        PART=PA/(1.+PA)
1060=        PN=EXP(B0+B1*LX)
1070=        P=PN/(1.+PN)
1080=        P=P/PART
1090=        PT=TF/P
1100=        DELCX=GTOTAL-PT
1110=        PP=P
1120=        DD=0.
1130=        DO 206 I=1,K
1140=        IF(I.GT.LX)GO TO 700
1150=        P=CCM(I)/GTOTAL
1160=        QQ=CCM(I)
1170=        EE=QQ-DD
1180=        DD=QQ
1190=        CM(I)=EE
1200=        GO TO 701
1210= 700    PN=EXP(B0+B1*I)
1220=        P=PN/(1.+PN)
1230=        P=P/PART
1240=        DELDEL=DELCX*(P-PP)/(1.-PP)
1250=        QQ=P*PT+DELDEL
1260=        EE=QQ-DD
1270=        DD=QQ
1280=        P=QQ/GTOTAL
1290=        CM(I)=EE
1300= 701    PRINT 105,I,P,QQ,EE
1310= 105    FORMAT(* *,I10,3E15.5)
1320= 206    CONTINUE
1330=        IXZ=1
1340=        KXZ=0
1350=        LXZ=NFYM+1
```

Figure 2-3. (Sheet 2 of 4)

```
1360=          C(1)=0.
1370=          DO 230 I=1,NFYM
1380= 230      C(1)=C(1)+CM(I)
1390=          DO 240 I=LXZ,K
1400=          IF(KXZ.EQ.0)IXZ=IXZ+1
1410=          IF(KXZ.EQ.0)C(IXZ)=0.
1420=          C(IXZ)=C(IXZ)+CM(I)
1430=          KXZ=KXZ+1
1440= 240      IF(KXZ.EQ.12)KXZ=0
1450=          SUM=0.
1460=          PRINT 316
1470= 316      FORMAT(* THE YEARLY DATA.*)
1480=          PRINT 1821
1490= 1821     FORMAT(* YEAR, YEARLY COST, CUMULATIVE COST.*)
1500=          L4L=(K-NFYM)/12
1510=          KA=L4L*12
1520=          IF(KA.EQ.K)L93=L4L+1
1530=          IF(KA.NE.K)L93=L4L+2
1540=          DO 241 I=1,L93
1550=          SUM=SUM+C(I)
1560=          PRINT 250,I,C(I),SUM
1570= 250      FORMAT(* *,I10,2E15.5)
1580= 241      CONTINUE
1590=          STOP
1600=C
1610=C   ********ARRAYS********
1620=C
1630=C        C(20) YEARLY COSTS THEN CUMULATIVE COSTS.
1640=C
1650=C        CM(240)  CUMULATIVE MONTHLY COST PROFILE.  ALSO USED IN CALCULATI
1660=C            ONS.
1670=C
1680=C        CCM(240)  CUMULATIVE MONTHLY COST PROFILE. (YES, LIKE ARRAY CM)
1690=C
1700=C   ********ARRAYS********
1710=C
1720=C   ********VARIABLES********
1730=C
1740=C        N NUMBER OF YEARS.
1750=C
1760=C        NM1 NUMBER OF YEARS MINUS 1.
1770=C
1780=C        TOTAL TOTAL COST BEFORE SCHEDULE CHANGES.
1790=C
1800=C        TF MODIFIED FUNDING VALUE.
1810=C
1820=C        J YEAR IN WHICH MODIFIED FUNDING VALUE IS APPLICABLE.
1830=C
1840=C        DEL CHANGE IN FUNDING IN THE DESIGNATED YEAR J.
1850=C
1860=C        NFYM NUMBER OF MONTHS IN THE FIRST YEAR.
1870=C
1880=C        NLYM NUMBER OF MONTHS IN THE LAST YEAR.
1890=C
1900=C        NXY DESIGNATES THE FIRST MONTH OF THE SECOND YEAR.
1910=C
1920=C        NYZ TOTAL MONTHS MINUS THE MONTHS IN THE LAAST YEAR.
1930=C
1940=C        MK DESIGNATES THE FIRST MONTH OF THE LAST YEAR.
1950=C
1960=C        MS DESIGNATES LAST MONTH OF LAST YEAR.
1970=C
1980=C        SXX SUM OF THE X-SQUARED TERMS.
1990=C
```

Figure 2-3. (Sheet 3 of 4)

```
2000=C      SXY SUM OF THE X*Y TERMS.
2010=C
2020=C      SX SUM OF THE X TERMS.
2030=C
2040=C      SY SUM OF THE Y TERMS.
2050=C
2060=C      B1 SLOPE OF THE REGRESSION LINE FOR THE TRANSFORMED VARIABLES.
2070=C
2080=C      B0 INTERCEPT OF THE REGRESSION LINE OF THE TRANSFORMED VARIABLES.
2090=C
2100=C      DELC INCREASED COST.
2110=C
2120=C      GTOTAL TOTAL COST BASED UPON MODIFIED COST.
2130=C
2140=C      N THE NEW NUMBER OF MONTHS IN THE SCHEDULE.
2150=C
2160=C      LX NUMBER OF MONTHS BEFORE CHANGE IN SCHEDULE BECAME EFFECTIVE.
2170=C
2180=C      PART  FACTOR FOR DETERMINING FRACTION OF THE CUMULATIVE
2190=C       DISTRIBUTION OF TOTAL COSTS USED.
2200=C
2210=C      P FACTOR FOR DETERMINING FRACTION OF COSTS BEFORE COST
2220=C       MODIFICATION.
2230=C
2240=C      DELCX COSTS TO BE ALLOCATED AFTER COSTING MODIFICATION.
2250=C
2260=C  #########VARIABLES#########
2270=C
2280=C  +++++++++DO-LOOPS+++++++++
2290=C
2300=C      200 CONVERTS YEARLY COSTS TO CUMULATIVE YEARLY COSTS.
2310=C
2320=C      201 CREATES NEW FUNDING PROFILE.
2330=C
2340=C      210 DEVELOPES CUMULATIVE MONTHLY COSTS DURING THE FIRST YEAR.
2350=C
2360=C      211 DEVELOPES CUMULATIVE MONTHLY COSTS FOR ALL BUT THE FIRST
2370=C          AND LAST YEARS.
2380=C
2390=C      212 DEVELOPES CUMULATIVE MONTHLY COSTS FOR LAST YEAR.
2400=C
2410=C      1000 PRINTS OUT MODIFIED MONTHLY COST PROFILE.
2420=C
2430=C      202 STORES CUMULATIVE MONTHLY COSTS IN CCM(.).
2440=C          FORMS A CUMULATIVE DISTRIBUTION IN CM(.) AFTER VARIABLE
2450=C          TRANSFORMATION.
2460=C
2470=C      203 CALCULATES THE SUM OF THE X, Y, X*X, AND X*Y TERMS.
2480=C
2490=C      204 DETERMINES NEW SCHEDULE END POINT.
2500=C
2510=C      206 CALCULATES AND OUTPUTS NEW COST SCHEDULE.
2520=C
2530=C      230 CONVERTS FROM MONTHLY TO YEARLY VALUES FOR THE FIRST YEAR.
2540=C
2550=C      240 CONVERTS FROM MONTHLY TO YERLY VALUES FOR ALL YEARS BUT FIRST
2560=C
2570=C      241 OUTPUTS YEARLY COST DATA.
2580=C
2590=C  +++++++++DO-LOOPS+++++++++
2600=C
2610=      END
```

Figure 2-3.   (Sheet 4 of 4)

```
ENTER THE NUMBER OF YEARS, COUNT ANY PORTION OF A YEAR  AS A YEAR.4

ENTER THE YEARLY COSTS.6000000.,12000000.,15000000.,3000000.

ENTER THE MODIFIED FUNDING VALUE (CUMULATIVE) AND ASSOCIATED TIME.29000000.,3

ENTER THE NUMBER OF MONTHS IN THE FIRST AND LAST YEAR.6,5

FOR A DISPLAY OF THE MONTHLY MODIFIED COST PROFILE ENTER 1, OTHERWISE EN
TER 2.1

MONTH    CUMULATIVE COST.
   1        .10000E+07
   2        .20000E+07
   3        .30000E+07
   4        .40000E+07
   5        .50000E+07
   6        .60000E+07
   7        .70000E+07
   8        .80000E+07
   9        .90000E+07
  10        .10000E+08
  11        .11000E+08
  12        .12000E+08
  13        .13000E+08
  14        .14000E+08
  15        .15000E+08
  16        .16000E+08
  17        .17000E+08
  18        .18000E+08
  19        .18917E+08
  20        .19833E+08
  21        .20750E+08
  22        .21667E+08
  23        .22583E+08
  24        .23500E+08
  25        .24417E+08
  26        .25333E+08
  27        .26250E+08
  28        .27167E+08
  29        .28083E+08
  30        .29000E+08
  31        .29600E+08
  32        .30200E+08
  33        .30800E+08
  34        .31400E+08
  35        .32000E+08
ENTER THE PERCENTILE WHICH WILL BE CONSIDED 100 % ..97
```

Figure 2-4. Example of Use of EST1000 (Sheet 1 of 2)

```
THE NEW NUMBER OF MONTHS IS  37
THE INCREASED COST IS     .20571E+07
MONTH, CUMULATIVE %, CUMULATIVE COST, MONTHLY COST.
           1    .26276E-01    .10000E+07    .10000E+07
           2    .52553E-01    .20000E+07    .10000E+07
           3    .78829E-01    .30000E+07    .10000E+07
           4    .10511E+00    .40000E+07    .10000E+07
           5    .13138E+00    .50000E+07    .10000E+07
           6    .15766E+00    .60000E+07    .10000E+07
           7    .18393E+00    .70000E+07    .10000E+07
           8    .21021E+00    .80000E+07    .10000E+07
           9    .23649E+00    .90000E+07    .10000E+07
          10    .26276E+00    .10000E+08    .10000E+07
          11    .28904E+00    .11000E+08    .10000E+07
          12    .31532E+00    .12000E+08    .10000E+07
          13    .34159E+00    .13000E+08    .10000E+07
          14    .36787E+00    .14000E+08    .10000E+07
          15    .39414E+00    .15000E+08    .10000E+07
          16    .42042E+00    .16000E+08    .10000E+07
          17    .44670E+00    .17000E+08    .10000E+07
          18    .47297E+00    .18000E+08    .10000E+07
          19    .49706E+00    .18917E+08    .91667E+06
          20    .52115E+00    .19833E+08    .91667E+06
          21    .54523E+00    .20750E+08    .91667E+06
          22    .56932E+00    .21667E+08    .91667E+06
          23    .59341E+00    .22583E+08    .91667E+06
          24    .61749E+00    .23500E+08    .91667E+06
          25    .64158E+00    .24417E+08    .91667E+06
          26    .66567E+00    .25333E+08    .91667E+06
          27    .68975E+00    .26250E+08    .91667E+06
          28    .71384E+00    .27167E+08    .91667E+06
          29    .73793E+00    .28083E+08    .91667E+06
          30    .76201E+00    .29000E+08    .91667E+06
          31    .91292E+00    .30937E+08    .19375E+07
          32    .85698E+00    .32614E+08    .16769E+07
          33    .89498E+00    .34060E+08    .14460E+07
          34    .92764E+00    .35303E+08    .12429E+07
          35    .95563E+00    .36369E+08    .10654E+07
          36    .97957E+00    .37280E+08    .91102E+06
          37    .10000E+01    .38057E+08    .77745E+06
THE YEARLY DATA.
YEAR, YEARLY COST, CUMULATIVE COST.
           1    .60000E+07    .60000E+07
           2    .12000E+08    .18000E+08
           3    .11000E+08    .29000E+08
           4    .90571E+07    .38057E+08
```

Figure 2-4. (Sheet 2 of 2)

14

APPENDIX
EAGLE USER'S GUIDE

SIGN ON PROCEDURE

Dial 5180

ASD COMPUTER CENTER INTERCOM 4.5
SYSTEM   CSA
DATE   08/08/77   TIME   17.26.45.

PLEASE LOGIN
LOGIN,A770310,COSTM,034,SUP.

COMMAND--EDITOR

. ATTACH,EAGLE1

PFN IS
EAGLE1
PF CYCLE NO - 007
. EAGLE1

EAGLE

COMPUTER DESCRIPTION OF SUBROUTINE GCS

THE FOLLOWING IS APPLICABLE TO THE MAIN ROUTINE ONLY. IF IN RESPONSE TO AN *INTEGER REQUEST* 1000 PLUS ONE OF CERTAIN SPECIFIED STATEMENT NUMBERS IS INPUT THEN THE USER IS SENT DIRECTLY TO THAT STATEMENT NUMBER. THUS, FOR EXAMPLE, A RESPONSE OF 1088 WOULD SEND THE USER TO STATEMENT 88 WHICH REQUESTS THE NUMBER OF YEARS OF INTEREST. THIS IS APPLICABLE FOR THE FOLLOWING STATEMENT NUMBERS.

STATEMENT NUMBER		REQUESTS
88	YEARS SPECIFICATION	
400	ROWS SPECIFICATION	
401	*INPUT FILES*	
402	ROW MODIFICATION	
403	*ELEMENT MODIFICATION*	
404	ROW INSERTION	
405	PRODUCTION SCHEDULE	
406	HEADING ARRAY SPECIFICATION	
77	CALCULATIONS	
407	SPREADING THE DATA	
408	ALLOWING FOR INFLATION	
677	OUTPUT	
409	ARRAY CHECK	
410	STORE FILES	
411	TERMINATE	
425	COLUMN INSERT	

USER'S GUIDE

DESCRIPTION OF ROUTINES

CAL	—INTERFACES THE VARIOUS ROUTINES WHICH PERFORM THE NUMERICAL CALCULATIONS.
CAL2	—CALCULATES THE COSTS WHEN SEVERAL DIFFERENT LEARNING RATES ARE USED.
SPREAD	—THIS ROUTINE SPREADS THE COSTS.
CAL1	—CALCULATES COST BASED UPON A SINGLE FIRST UNIT COST AND LEARNING RATE.
OUT	—THIS ROUTINE OUTPUTS THE COST DATA *WITH* ASSOCIATED HEADINGS.
PRODUC	—THIS ROUTINE ALLOWS SPECIFICATION OF THE PRODUCTION SCHEDULE.
MAIN	—THIS ROUTINE ALLOWS THE USER TO INTERFACE AND COORDINATE THE *OTHER ROUTINES*.
ESCALAT	—THIS ROUTINE ALLOWS THE EFFECTS OF INFLATION TO BE INCLUDED IN THE ANALYSIS.
HARCON	—THIS ROUTINE ALLOWS THE USER TO DESIGNATE THE COST HEADINGS.
CAL3	—CALCULATES A FRACTION OF PREVIOUSLY CALCULATED ROW.
CAL4	—ENABLES THE DIRECT SPECIFICATION OF A SET OF COSTS.
CAL5	—ENABLES AN *INTERFACE* WITH THE OTHER ROUTINES WHEN A ROW IS THE SUM OF SEV'L CAL.
NEWRA	—CALCULATES A NEW FIRST UNIT COST WHEN THERE IS A CHANGE IN THE LEARNING RATE.
HELP	—PROVIDES ASSISTANCE TO USER IN DIFFICULTY OR ONE SEEKING A BETTER UNDERSTANDING
ADDL	—ADDS PREVIOUSLY CALCULATED ROWS AND MULTIPLIES THEM BY A CONSTANT.
FILES	—ENABLES THE STORING OR OBTAINING OF ARRAYS ON FILES.
ROWMOD	—ENABLES THE MODIFICATION OF A SINGLE ROW.
DIVIDEL	—ENABLES THE DIVISION OF ONE ROW BY A SECOND AND FORMING A NEW ROW USING THE QUOT.
ELEMENT	—ENABLES THE CHANGING OF A SPECIFIC ARRAY ELEMENT.
RINSERT	—ENABLES THE INSERTION OF A ROW INTO AN ARRAY.
CUM	—CONVERTS (CUMULATIVE COSTS + LEARNING RATE) TO (FIRST UNIT COST + LEARNING RATE).
APRINT	—ENABLES ARRAYS TO BE OUTPUT.
GCS	—ENABLES RAPID TRANSFER FROM ONE LOCATION IN THE MAIN ROUTINE FROM 1 LOC. TO A 2ND.
INTEPR	—ENABLES AN INTEGER PRINTOUT OF THE COST ARRAY.
T1SL	—ENABLES THE CALCULATION OF FIRST UNIT COST AND RATE BASED ON 2 GRP COSTS.
CINSERT	—ENABLES THE INSERTION OF A COLUMN IN THE COST ARRAY.
NAMCHK	—ASSURES THAT THE INPUT FOR A FILE NAME IS PERMISSIBLE.
TRANSTO	—TRANSFERS THE HEADING, COST AND PRODUCTION SCHEDULE ARRAYS TO FILES.
TRANSFR	—READS THE HEADING, COST AND PRODUCTION SCHEDULE ARRAYS FROM FILES.
MULT	—MULTIPLIES ONE ROW BY A SECOND TO FORM A NEW ROW.

CALCULATING INDICES

EACH COST ELEMENT (ROW) IS CALCULATED SEPARATELY. THERE ARE 11 METHODS OF CALCULATION. THESE ARE NOW DESCRIBED ALONG WITH THE NUMBER BY WHICH THEY CAN BE REQUESTED.

(1) UNIT LEARNING CURVE, SINGLE LEARNING RATE.
(2) UNIT LEARNING CURVE, MULTIPLE RATES.
(3) A FRACTION OF A PREVIOUS LINE.
(4) A SET OF CONSTANTS.
(5) MULTIPLE USE OF THE OTHER METHODS OF CALCULATION.
(6) *THE ROW REMAINS UNCHANGED FROM THE ROW CALCULATED IN THE PREVIOUS RUN.*
(7) SPECIFIED ROWS ARE SUMMED AND MULTIPLIED BY A SPECIFIED CONSTANT.
(8) QUOTIENT OF ONE ROW DIVIDED BY ANOTHER.
(9) CUMULATIVE COSTS PLUS LEARNING RATE.
(10) 2 PRODUCTION LOTS AND ASSOCIATED COSTS ARE SPECIFIED AND A FIRST UNIT COST AND ASSOCIATED LEARNING RATE IS CALCULATED.
(11) PRODUCT OF ONE ROW MULTIPLIED BY ANOTHER.

SAVING DATA FILES	SAVING MODIFIED DATA FILE	SAVING FOR REMOTE PRINTOUT
. E,TAPE4,S	. REQUEST,XX,*PF	. E,TAPE3,S
. REWIND,TAPE4	. SAVE,XX,N,O	. REWIND,TAPE3
. SAVE,P-F-N,N	. CATALOG,XX,P-F-N	. SAVE,P-F-N,N
. STORE,P-F-N		. STORE,P-F-N
ID- A770310		ID- A770310

(In the above, P-F-N represents the permanent file name chosen by the user.)

If the user wishes to ensure that the file is not automatically destroyed(purged) after a given time, then the command sequence should read:

```
. STORE,P-F-N,RP=999
        or
. CATALOG,XX,P-F-N,RP=999
```

SENDING OUTPUT TO REMOTE SITE

The following commands will cause a file, say ZKH, to be printed at a remote site:

```
. ATTACH,XX,ZKH
. REWIND,XX
. COPYSBF,XX,OUTPUT
. ROUTE,OUTPUT,TID= AD, FID= AA2,DC= PR
```

In the above, "AA2" is a label that permits the user to better identify his output. Any set of characters, up to seven, can be used. "AD" is the location specification, in this case, Building 17.

DATA FILE "MOD" AS INPUT

```
. ATTACH,EAGLE1
. ATTACH,MOD
. .EAGLE1,MOD
```

CLEARING LOCAL FILE

Assume that files XX and ABC are present.

```
. .FILES
. RETURN,XX,ABC
```

PURGING "DFN" FILE

```
. PURGE,A,DFN
```

MODIFYING DATA FILES

```
. ATTACH,ABC,DFN
. .E,ABC,S
```

LISTING AND DELETING LINES

Command	Meaning
. L,A	List all of the file
. L, # (e.g., L,9840)	List the line numbered 9840
. L, #₁, #₂ (e.g., L,9950,10140)	List the lines numbered 9950 through 10140
. L,A,/XYZ/	List all lines having the character set "XYZ". The "/" is a delineator. If the XYZ character set contains such a symbol, then the use of "*" or "&" is recommended.
. D, # (e.g., D,7200)	Delete the line 7200 from the file.
. D, #₁, #₂ (e.g., D,8410,8450)	Delete lines 8410 and 8450 and all lines in between.

ADDING LINES

To add the two lines

```
1409
1
```

between the lines 7450 and 7460. The user then would input

```
7451= 1409
7452= 1
```

CHANGING LINES

```
/ABC/=/DEFG/,8360,V
```

This is a command to change every character set ABC in line 8360 to character set DEFG, with verification required. The computer will now display the new line 8360; and if satisfactory, the user will respond "YES".

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 1982-01-1-1756	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Enhancement of Computer Program Eagle		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) P. Orth		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS ARINC Research Corporation 2551 Riva Road Annapolis, Maryland 21401		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Aeronautical Systems Division Wright-Patterson Air Force Base, Ohio		12. REPORT DATE MAY 1978
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18. SUPPLEMENTARY NOTES

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A project conducted by ARINC Research Corporation to enhance the capabilites of computer program EAGLE is desribed. Results of the task, preformed for Aeronautical Systems Division, are presented as follows: Volume 1, project summary; volume 11, Eagle program listing; and volume 111 quick program listing.

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